This document contains Part 1 (pp.1–20) of Chapter 1 of the National Coastal Condition Report III.

The entire report can be downloaded from http://www.epa.gov/nccr

National Coastal Condition Report III

Chapter 1: Introduction

Part 1 of 2

December 2008

CHAPTER 1

Introduction

Courtesy of John Theilgard

Introduction

The *National Coastal Condition Report* series assesses the condition of the estuarine, Great Lakes, and coastal embayment waters (collectively referred to as "coastal waters" in this report) and offshore fisheries of the United States. The first *National Coastal Condition Report* (NCCR I; U.S. EPA, 2001c) assessed the condition of the nation's coasts using data collected from 1990 to 1996 that were provided by several existing coastal programs, including the U.S. Environmental Protection Agency's (EPA's) Environmental Monitoring and Assessment Program (EMAP), the U.S. Fish and Wildlife Service's (FWS's) National Wetlands Inventory (NWI), and the National Oceanic and Atmospheric Administration's (NOAA's) National Status & Trends (NS&T) Program. The second *National Coastal Condition Report* (NCCR II; U.S. EPA, 2004a) provided information similar to the information covered in the NCCR I, but contained more recent (1997–2000) data from these monitoring programs, as well as data from EPA's National Coastal Assessment (NCA) and NOAA's National Marine Fisheries Service (NMFS). The data provided by the NCA allowed for the development of coastal condition indicators for 100% of the coastal area of the conterminous 48 states and Puerto Rico.

This third *National Coastal Condition Report* (NCCR III) is a collaborative effort among EPA, NOAA, FWS, and the U.S. Geological Survey (USGS), in cooperation with other agencies representing states and tribes. The NCCR III continues the *National Coastal Condition Report* series by providing updated regional and national assessments of the condition of the nation's coastal waters, including the coastal waters of Hawaii and the southcentral portion of Alaska (henceforth referred to as Southcentral Alaska), based primarily on NCA data collected in 2001 and 2002. No new information was available for the regions of Puerto Rico or the Great Lakes; therefore, the chapters covering these regions represent summaries of the assessments presented in the NCCR II. The assessment of offshore fisheries provided in this report is based on long-term data collected since monitoring of the individual fisheries began. In addition, this report examines national and regional (Northeast, Southeast, and Gulf coasts) trends in coastal condition from the early 1990s to 2002.

NCA surveys of the nation's coastal waters have been conducted annually from 2000 to 2006. The results of surveys conducted after 2002 will be available in 2008 and will be presented in the fourth *National Coastal Condition Report* (NCCR IV) in 2011.

Purpose of This Report

The purpose of the NCCR III is to present a broad baseline picture of coastal condition for coastal waters across the United States for 2001 and 2002 and, where available, snapshots of the condition of fisheries in offshore waters. This report is written for the informed public, coastal managers, scientists, members of Congress, and other elected officials. English units are used in most of the report because these units are most familiar and best understood by the target audience in the United States. The NCCR III uses currently available data sets to discuss the condition of the nation's coastal waters and is not intended to be a comprehensive literature review of coastal information. Instead, this report uses NCA and other monitoring data on a variety of indicators to provide insight into current coastal condition. The NCCR III also examines national and regional trends in coastal condition from the early 1990s to 2002. The NCCR III will serve as a continuing benchmark for providing data to analyze the progress of coastal programs and will be followed in subsequent years by reports on more specialized coastal issues. This report will also serve as a reminder of the data gaps and other pitfalls that natural resource managers face and must try to overcome to make reliable assessments of how the condition of the nation's coastal resources may change with time.

In addition to the regional assessments provided in this report, the NCCR III includes special Highlight articles that describe several exemplary programs related to coastal condition at the federal, state, and local levels. The Highlight articles are intended to enhance the discussion of coastal condition as it is presented in the main body of the report text. These articles offer insight into other methods or indicators used to measure and assess coastal condition, programs used to improve coastal condition, and government programs developed in response to the coastal condition findings (including identified data limitations and areas found to be in poor condition). The Highlight articles are not intended to be comprehensive or exhaustive summaries of all coastal programs, but are presented to show that information about the health of coastal systems is being collected for decision making at the local, state, regional, and national levels.

The final chapter of this report (Chapter 9) explores the connections between the condition indicators and human uses of coastal areas. Although the type of assessment described in Chapter 9 cannot be conducted on scales larger than a single estuary, it is important to address coastal condition at several spatial scales (e.g., national, regional, state, and local). Chapter 9 also complements the national/regional approach by combining the site-specific information for a single estuary, Narragansett Bay, with the NCA results for this estuary to evaluate coastal condition.

Why Are Coastal Waters Important?

Coastal Waters Are Valuable and Productive Natural Ecosystems

Coastal waters include estuaries, coastal wetlands, seagrass meadows, coral reefs, intertidal zones, mangrove and kelp forests, and coastal ocean and upwelling areas. Critical coastal habitats provide spawning grounds, nurseries, shelter, and food for finfish, shellfish, birds, and other wildlife. The coasts also provide essential nesting, resting, feeding, and breeding habitat for 75% of U.S. waterfowl and other migratory birds (U.S. EPA, 1998b).

Estuaries are bodies of water that receive freshwater and sediment influx from rivers and tidal influx from the oceans, thus providing transition zones between the fresh water of a river and the saline environment of the sea. This interaction produces a unique environment that supports wildlife and fisheries and contributes substantially to the economy of coastal areas. Estuaries also supply water for industrial uses; lose water to freshwater diversions for drinking and irrigation; are the critical terminals of the nation's marine transportation system and the U.S. Navy; provide a point of discharge for municipalities and industries; and are the downstream recipient of nonpoint-source runoff.

Coastal wetlands are the interface between the aquatic and terrestrial components of estuarine systems. Wetland habitats are critical to the life cycles of fish, shellfish, migratory birds, and other wildlife and help improve surface water quality by filtering residential, agricultural, and industrial wastes. Wetlands also buffer coastal areas against storm and wave damage; however, because of their close interface with terrestrial systems, wetlands are vulnerable to land-based sources of pollutant discharges and other human activities.

Rocky intertidal zones provide habitat for a variety of species, including these sea stars in Kachemak Bay, AK (courtesy of NOAA).

Coastal Waters Have Many Human Uses

Coastal areas are the most developed areas in the United States. This narrow fringe of land—only 17% of the total conterminous U.S. land area—is home to more than 53% of the nation's population (Figure 1-1). The total coastal population between the years 1980 and 2003 increased by 33 million people (28%), which is roughly consistent with the nation's rate of increase; however, continued population growth in this limited coastal land area results in increased population density and pressure on coastal resources. The majority of the nation's most densely populated areas are located along the coast. In fact, 23 of the 25 most densely populated U.S. counties are coastal counties. The population density of U.S. coastal counties averages 300 persons/square mile (mi^2), much higher than the national average of 98 persons/mi^2 (Crossett et al., 2004).

In addition to being a popular place to live, the nation's coasts are of great recreational value. Beaches have become one of the most popular vacation destinations in the United States, with 180 million people visiting the nation's coasts each year (Cunningham and Walker, 1996). From 1999 to 2000, more than 43% of the U.S. population participated in marine recreational activities, including sport fishing, boating, swimming, and diving (Leeworthy and Wiley, 2001).

Human use of coastal areas also provides commercial services for the nation. The 425 U.S. coastal counties generate $1.3 trillion of the gross national product (GNP), and coastal and marine waters support more than 28 million jobs (Leeworthy, 2000; U.S. Senate, 2003). The annual landings total of U.S. commercial fisheries was 5 million metric tons (t) from 2001 through 2003, approximately 4.1% of the world's annual landings (NMFS, 2002; 2003; 2004). Roughly 35% of the nation's commercial landings are taken within 3 miles of shore (NMFS, 2004).

Why Be Concerned about Coastal Condition?

Because a disproportionate percentage of the nation's population reside in coastal areas, the activities of municipalities, commerce, industry,

Figure 1-1. Population distribution in the United States based on 2000 U.S. Census Bureau data (U.S. Census Bureau, 2001).

and tourism have created environmental pressures that threaten the very resources that make coastal living desirable. Population pressures include increased solid waste production; higher volumes of urban nonpoint-source runoff; loss of green space and wildlife habitat; declines in ambient water and sediment quality; and increased demands for wastewater treatment, irrigation and potable water, and energy supplies. Development pressures have resulted in substantial physical changes along many areas of the coastal zone. Coastal wetlands continue to be lost to residential and commercial development, and the quantity and timing of freshwater flow, which is critical to riverine and estuarine function, continue to be altered. In effect, the same human uses that are desired of coastal habitats also have the potential to lessen their value. This report not only discusses the indicators of coastal condition that gauge the extent to which coastal habitats and resources have been altered, but it also addresses connections between coastal condition and the ability of coastal areas to meet human expectations for their use.

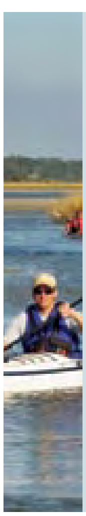
Assessment of Coastal Condition

Three sources of coastal information use nationally consistent data-collection designs and methods—EPA's NCA, NOAA's NS&T Program, and FWS's NWI. The NCA collects data from all coastal areas in the United States, except the Great Lakes region, and these data are representative of all coastal waters. The NS&T Program collects data from all coastal regions in the United States; however, the design of this survey does not permit extrapolation of the data to represent all coastal waters. The NWI provides estimates of wetland acreage (including coastal wetlands) by wetland type based on satellite reconnaissance of all U.S. states and territories.

This report examines several available data sets from different agencies and areas of the country and summarizes them to present a broad baseline picture of the condition of the nation's coastal waters. Three types of data are presented in this report:

- Coastal monitoring data from programs such as EPA's EMAP and NCA, NOAA's NS&T Program, and FWS's NWI, along with data from the Great Lakes National Program Office (GLNPO), have been analyzed for this report and were used to develop indices of coastal condition
- Fisheries data for Large Marine Ecosystems (LMEs) from NOAA's NMFS
- Assessment and advisory data provided by states or other regulatory agencies and compiled in national EPA databases.

This report presents available coastal monitoring information on a national scale for the 50 states and Puerto Rico; these data are then broken down and analyzed by geographic region in six chapters: Northeast Coast; Southeast Coast; Gulf Coast; West



Why Doesn't This Assessment Use More of the Available Data Sets?

Many other sets of monitoring data are available for estuarine and coastal areas around the United States; however, these data sets were not included in this report for several reasons. Most of these data sets were not collected using a probabilistic sampling design and, therefore, are not representative of the entire region covered by the sampling program. For example, the locations of the monitoring stations used to collect the data may have been selected to meet specific program goals, such as monitoring water quality near wastewater-discharge points. Also, these monitoring programs are conducted by different agencies or organizations and use various methods for data collection, analysis, and evaluation. The parameters and time frames monitored may also vary between monitoring programs. These types of monitoring programs often provide long-term data suitable for assessing program goals or coastal condition in the areas targeted by these efforts; however, it would be difficult to compare these data sets on a regional or national basis to assess coastal condition.

Coast; Great Lakes; and Alaska, Hawaii, and the Island Territories. In most cases, these geographic regions roughly coincide with the borders of the 10 LMEs surrounding U.S. states and island territories (Figure 1-2, Table 1-1). Assessment and advisory data for the regions are presented at the end of each chapter. Although inconsistencies in the way different state agencies collect and provide assessment and advisory data prevent the use of these data for comparing conditions between coastal areas, the information is valuable because it helps identify and illuminate some of the causes of coastal impairment, as well as the impacts of these impairments on human uses.

Table 1-1. Comparison of NCA's Reporting Regions and NOAA's LMEs

NCA Reporting Regions	NOAA LMEs
Northeast Coast	Northeast U.S. Continental Shelf LME
Southeast Coast	Southeast U.S. Continental Shelf LME
Gulf Coast	Gulf of Mexico LME
West Coast	California Current LME
Alaska	East Bering Sea LME, Gulf of Alaska LME, Chukchi Sea LME, Beaufort Sea LME
Hawaii	Insular Pacific-Hawaii LME
Puerto Rico	Caribbean Sea LME

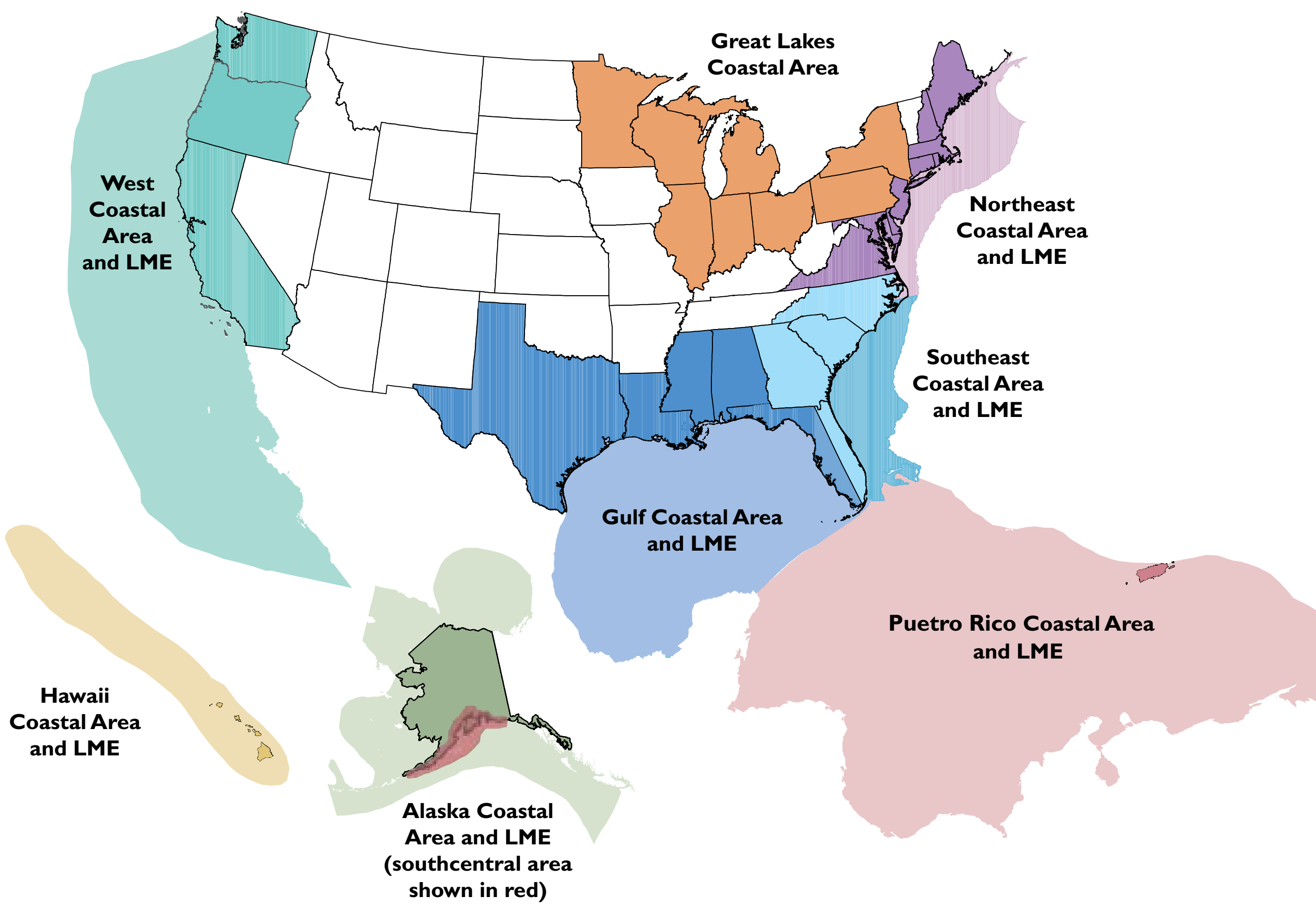
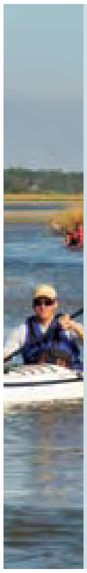


Figure 1-2. Coastal and Large Marine Ecosystem (LME) areas presented in the chapters of this report (U.S. EPA/NCA).



NCA Provides a "Snapshot" of Conditions in U.S. Coastal Waters

NCA uses a probabilistic sampling design to designate sampling-station locations and collects a single sample from each station on a single day in the summer of each year when sampling occurs. These samples are collected and analyzed in a consistent manner to create areal estimates of condition with a known level of uncertainty (see Appendix A), and the results can be compared across the United States to create a "snapshot" of coastal condition (U.S. EPA, 2001b).

Coastal Monitoring Data

A large percentage of the data used in this assessment of coastal condition comes from programs administered by EPA and NOAA. EPA's NCA provides representative data on biota (e.g., plankton, benthos, and fish) and potential environmental stressors (e.g., water quality, sediment quality, and tissue bioaccumulation) for all coastal states (except states in the Great Lakes region) and Puerto Rico (Diaz-Ramos et al., 1996; Summers et al., 1995; Olsen et al., 1999; U.S. EPA, 2007b). The NCA data are stored in the EMAP National Coastal Database, available online at http://www.epa.gov/emap/nca/html/data/index.html. NOAA's NS&T Program provides site-specific data on toxic contaminants and their ecological effects for all coastal regions and Puerto Rico. Coastal condition is also evaluated using data from the NWI, which provides information on the status of the nation's wetlands acreage.

Five primary indices of environmental condition were created using data available from these national coastal programs: a water quality index, sediment quality index, benthic index, coastal habitat index, and fish tissue contaminants index. The five indices were selected because of the availability of relatively consistent data sets for these parameters for most of the country. The indices do not address all of the coastal characteristics that are valued by society, but they do provide information on both the ecological condition and human use of coastal waters. Component indicators for the water quality index (dissolved inorganic nitrogen [DIN], dissolved inorganic phosphorus [DIP], chlorophyll *a*, water clarity, and dissolved oxygen) and the sediment quality index (sediment toxicity, sediment contaminants, and sediment total organic carbon [TOC]) are also assessed in this report.

Characterizing coastal areas using each of the five indices involves two steps. The first step is to assess condition at an individual monitoring site for each index and component indicator. The site condition rating criteria for each index and component indicator in each region are determined based on existing criteria, guidelines, interviews with EPA decision makers, feedback from state and local decision makers, and/or the interpretation of scientific literature. For example, dissolved oxygen conditions (a component indicator of the water quality index) are considered poor if the dissolved oxygen concentration measured at a site is less than 2 mg/L. This value is widely accepted as representative of hypoxic (low dissolved oxygen) conditions; therefore, this benchmark for poor condition is strongly supported by scientific evidence (Diaz and Rosenberg, 1995; U.S. EPA, 2000a). See Appendix A for additional information on how the rating criteria were determined.

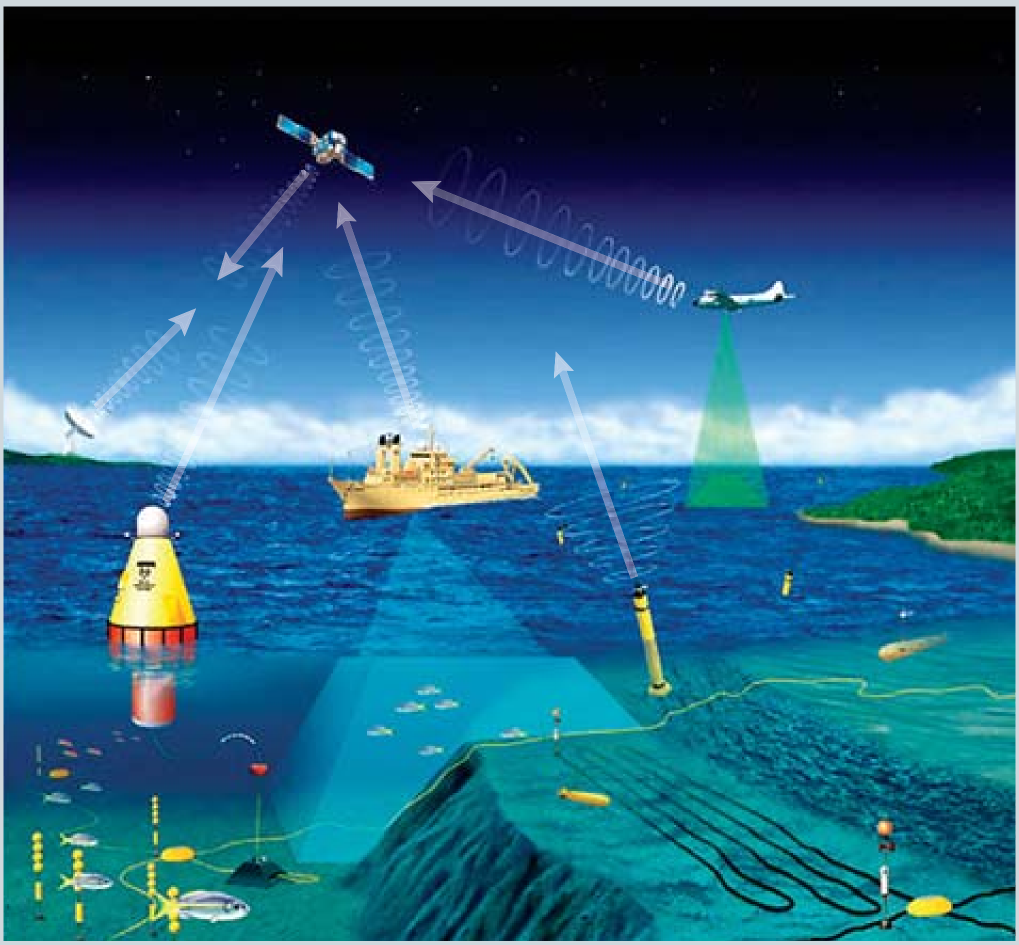
The second step is to assign a regional index rating based on the condition of the monitoring sites within the region. For example, for a region to be rated poor for the dissolved oxygen component indicator, sampling sites representing more than 15% of the coastal area in the region must have measured dissolved oxygen concentrations less than 2 mg/L and be rated poor. The regional criteria boundaries (i.e., percentages used to rate each index of coastal condition) were determined as a median of responses provided through a survey of environmental managers, resource experts, and the knowledgeable public. The following sections provide detailed descriptions of each index and component indicator, as well as the criteria for determining the regional ratings for the five indices as good, fair, or poor.

Highlight

U.S. Integrated Ocean Observing System

Today, many changes that profoundly affect our society are occurring in the oceans—from sea-level rise, hurricanes, and coastal flooding to the occurrence of harmful algal blooms (HABs), fish kills, declining fisheries, and environmental pollution. To address these problems, the U.S. Commission on Ocean Policy, the National Ocean Research Leadership Council, and the U.S. Ocean Action Plan (CEQ, 2004) have identified the development of the U.S. Integrated Ocean Observing System (IOOS) as a high priority. The IOOS will significantly improve the nation's ability to achieve the following goals:

- Improve predictions of weather and climate change and their effects on coastal communities and the nation



Data are collected at IOOS observation stations and transferred to the data management and communications subsystem (courtesy of Ocean.US).

- Improve the safety and efficiency of maritime operations
- More effectively mitigate the effects of natural hazards
- Improve national and homeland security
- Reduce public health risks
- More effectively protect and restore healthy coastal ecosystems
- Enable the sustained use of ocean and coastal resources.

Buoys are one type of observation platform used by IOOS (courtesy of Adrian Jones, IAN Network).

The IOOS will be a complex system that integrates several subsystems to meet these goals. These subsystems include observation, data management and communications (DMAC), and data modeling and analysis (Ocean.US, 2006). The IOOS observation subsystem will be a sustained network of buoys, satellites, ships, underwater vehicles, and other observation platforms that will routinely collect the data and information needed for rapid and timely detection of changes in our nation's estuaries, coastal waters, open ocean, and Great Lakes (Nowlin, 2001; Ocean.US, 2002). The DMAC subsystem will be composed of data systems, regional data centers, and archive centers that are connected by the Internet and use shared standards and protocols. The DMAC will integrate the coastal and global ocean components of the observation subsystem and serve as a link between the observation subsystem and the end users (Ocean.US, 2005a; 2005b). The data modeling and analysis subsystem will use real-time and historical data from the DMAC to evaluate and forecast the state of the marine environment (Ocean.US, 2005a).

The IOOS will be part of several larger systems that are used to assess the state of the environment worldwide. The IOOS is the U.S. contribution to the Global Ocean Observing System (GOOS) and will also serve as the estuarine-marine-Great Lakes component of the U.S. Integrated Earth Observation System (IEOS). IEOS includes ocean, terrestrial, atmospheric, and other observation systems and is the U.S. contribution to the Global Earth Observation System of Systems (GEOSS). The IOOS is a key contribution toward attaining the benefits of the GOOS, IEOS, and GEOSS.

The IOOS is currently under development. Under the oversight of the federal Interagency Working Group on Ocean Observations (IWGOO), the Ocean.US national office has generated and will continue to create various plans and documents for the development and implementation of the IOOS (Ocean.US, 2005a; 2006). Additional assistance is also being provided by the 11 U.S. IOOS Regional Associations that comprise the National Federation of Regional Associations (NFRA). Additional information about the IOOS, NFRA, and the Regional Associations' Regional Coastal Ocean Observing Systems may be found at Ocean.US's Web site at http://www.ocean.us or by contacting Brian Melzian (EPA/IWGOO) at melzian.brian@epa.gov.

Limitations of Available Data

Coastal surveys of Southcentral Alaska and Hawaii were completed in 2002, and assessments of these coastal waters are included in this report. These probabilistic surveys represented 20% of the Alaska's coastline and 100% of Hawaii's coastline (Sharma, 1979); however, NCA was unable to evaluate the benthic and coastal habitat indices for Southcentral Alaska and the benthic, coastal habitat, and fish tissue contaminants indices for Hawaii. Coastal condition in Alaska is difficult to assess because very little information is available for most of the state to support the type of analysis used in this report (i.e., spatial estimates of condition based on the indices and component indicators measured consistently across broad regions). Nearly 75% of the area of all the bays, sounds, and estuaries in the United States is located in Alaska, and no national report on coastal condition can be complete without information on the condition of the living resources and ecological health of these waters. Similarly, information to support estimates of condition based on the indices and component indicators used in this report is limited for Hawaii, the Pacific island territories (American Samoa, Northern Mariana Islands, and Guam), and the U.S. Virgin Islands. Although these latter systems make up only a small portion of the nation's coastal area, they represent a unique set of coastal subsystems (such as coral reefs and tropical bays) that are not located anywhere else in the United States, except for the Florida Keys and the Flower Gardens off the Texas/Louisiana coast. A survey of Puerto Rico's coastal condition was completed in 2000 and reported in the NCCR II. No new information has been collected for Puerto Rico since the NCCR II was published; therefore, a summary of that report's assessment is included in this NCCR III.

In order to attain consistent reporting for all the coastal ecosystems of the United States, fiscal and intellectual resources need to be invested in the creation of a national coastal monitoring program. The conceptual framework for such a program is outlined in the National Coastal Research and Monitoring Strategy (http://www.epa.gov/owow/oceans/nccr/H2Ofin.pdf), which calls for a national program that is organized at the state level and carried out by a partnership between federal departments and agencies (e.g., EPA, NOAA, the U.S. Department of the Interior [DOI], and the U.S. Department of Agriculture [USDA]), state natural resource and environmental agencies, academia, and industry. Such a monitoring program would provide the capability to measure, understand, analyze, and forecast ecological change at national, regional, and local scales. A first step in the development of this type of program was the initiation of EPA's NCA, a national coastal monitoring program organized and executed at the state level; however, the NCA is merely a starting point for developing a comprehensive national coastal monitoring program that can offer a coastal assessment of the entire nation at all appropriate spatial scales. The developers of the assessment continue to incorporate the new research findings and work with decision makers and coastal experts to improve the assessment methods and criteria. The NCA currently supports rigorous quality assurance (QA) and training programs for state, federal, and other partners collecting and analyzing the data to ensure consistency in the collection and analytical methods and to minimize discrepancies and other sources of error (see Appendix A). The NCA is designed to minimize spatial variability in national and regional estimates of coastal condition; however, the sampling index period does not address temporal

Bamboo coral provides refuge, settlement substrate, and feeding perches for crabs and larval fish on seamounts, such as this one in the Gulf of Alaska LME (courtesy of NOAA).

variability. One approach for examining coastal data at a more local spatial scale (an individual estuarine system) is presented in the assessment of Narragansett Bay provided in Chapter 9.

Indices Used to Measure Coastal Condition

Water Quality Index

The water quality index is based on measurements of five component indicators: DIN, DIP, chlorophyll *a*, water clarity, and dissolved oxygen. Some nutrient inputs to coastal waters (such as DIN and DIP) are necessary for a healthy, functioning estuarine ecosystem; however, when nutrients from various sources, such as sewage and fertilizers, are introduced into an estuary, their concentrations can increase above natural background levels. This

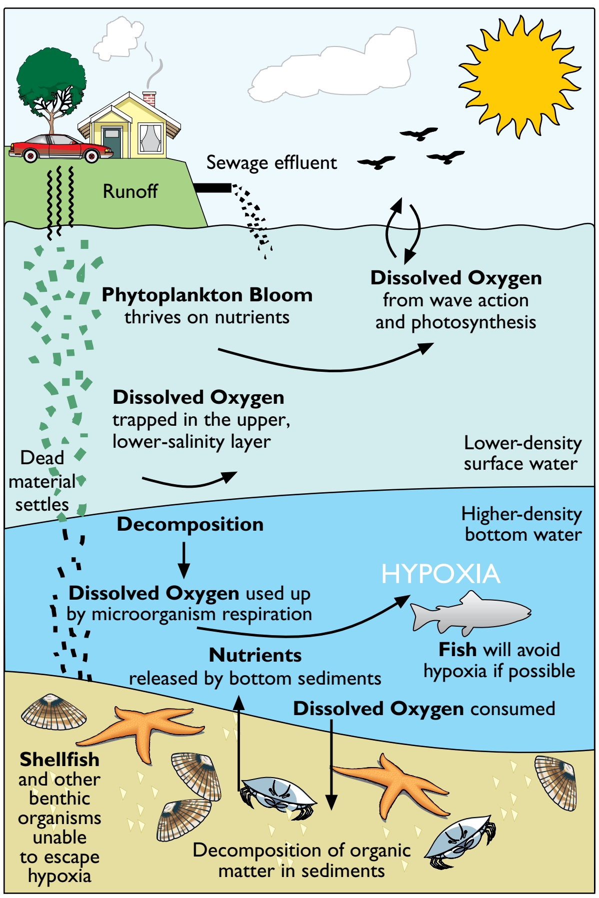


Figure 1-3. Eutrophication can occur when the concentration of available nutrients increases above normal levels (U.S. EPA/NCA).

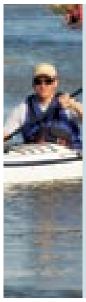
increase in the rate of supply of organic matter is called eutrophication and may result in a host of undesirable water quality conditions (Figure 1-3), including excess plant production (phytoplankton or algae) and increased chlorophyll *a* concentrations, which can decrease water clarity and lower concentrations of dissolved oxygen.

The water quality index used in this report is intended to characterize acutely degraded water quality conditions and does not consistently identify sites experiencing occasional or infrequent hypoxia (low dissolved oxygen conditions), nutrient enrichment, or decreased water clarity. As a result, a rating of poor for the water quality index means that the site is likely to have consistently poor condition during the monitoring period. If a site is designated as fair or good, the site did not experience poor condition on the date sampled, but could be characterized by poor condition for short time periods. Increased or supplemental sampling would be needed to assess the level of variability in the index at a specific site.

Nutrients: Nitrogen and Phosphorus

Nitrogen and phosphorus are necessary and natural nutrients required for the growth of phytoplankton, the primary producers that form the base of the food web in coastal waters; however, excessive levels of nitrogen and phosphorus can result in large, undesirable phytoplankton blooms. DIN is the nutrient type most responsible for eutrophication in open estuarine and marine waters, whereas DIP is more likely to promote algal growth in the tidal-fresh water parts of estuaries.

NCA data were only available for the dissolved inorganic forms of nitrogen and phosphorus (i.e., DIN and DIP), which were determined chemically through the collection of filtered surface water at each site. DIN and DIP represent the portion of the total nitrogen and phosphorus pool in estuarine and coastal waters that remains once these nutrients have been assimilated by phytoplankton, benthic microalgae, or higher aquatic plants. Although DIN and DIP alone are not adequate indicators of the trophic state or water quality of coastal waters, susceptibility to eutrophication may be indicated when high concentrations of DIN and DIP are observed along with high chlorophyll levels, poor



The NCA monitoring data used in this assessment were based on single-day measurements collected at sites throughout the U.S. coastal waters (excluding the Great Lakes) during a 9- to 12-week period in late summer. Data were not collected during other time periods.

water clarity, or hypoxia. This report also differs from results provided in the NOAA report because the nutrient assessment for the NCA surveys is based only on summer concentrations, rather than the annual average concentrations used by NOAA. Due to phytoplankton uptake and growth, nutrient concentrations in summer are generally expected to be lower than at other times of the year for most of the country (however, on the West Coast, Pacific upwelling events in summer often produce the year's highest nutrient concentrations). As a result, the DIN and DIP reference surface concentrations used to assess coastal condition in this report are generally lower than those in the NOAA report. Coastal monitoring sites were rated good, fair, or poor for DIN and DIP using the criteria shown in Tables 1-2 and 1-3. The site ratings were then used to calculate an overall rating for each region.

Chlorophyll a

One of the symptoms of degraded water quality condition is the increase of phytoplankton biomass as measured by the concentration of chlorophyll *a*. Chlorophyll *a* is a measure used to indicate the amount of microscopic algae (or phytoplankton) growing in a waterbody. High concentrations of chlorophyll *a* indicate the potential for problems related to the overproduction of algae. For this report, surface concentrations of chlorophyll *a* were determined from a filtered portion of water collected at each site. Surface chlorophyll *a* concentrations at a site were rated good, fair, or poor using the criteria shown in Table 1-4. The site ratings were then used to calculate an overall chlorophyll *a* rating for each region.

Water Clarity

Clear waters are generally valued by society for aesthetics and recreation. Water clarity in coastal waters is important for light penetration to support submerged aquatic vegetation (SAV), which serves as food and habitat for the resident biota. Water clarity is affected by physical factors such as wind and/or other forces that suspend sediments and particulate matter in the water; by chemical factors that influence the amount of dissolved organics

Table 1-2. Criteria for Assessing Dissolved Inorganic Nitrogen (DIN)

Area	Good	Fair	Poor
Northeast, Southeast, and Gulf Coast sites	< 0.1 mg/L	0.1–0.5 mg/L	> 0.5 mg/L
West Coast and Alaska sites	< 0.5 mg/L	0.5–1.0 mg/L	> 1 mg/L
Hawaii, Puerto Rico, and Florida Bay sites	< 0.05 mg/L	0.05–0.1 mg/L	> 0.1 mg/L
Regions	Less than 10% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition.	10% to 25% of the coastal area is in poor condition, or more than 50% of the coastal area is in combined poor and fair condition.	More than 25% of the coastal area is in poor condition.

Table 1-3. Criteria for Assessing Dissolved Inorganic Phosphorus (DIP)

Area	Good	Fair	Poor
Northeast, Southeast, and Gulf Coast sites	< 0.01 mg/L	0.01–0.05 mg/L	> 0.05 mg/L
West Coast and Alaska sites	< 0.01 mg/L	0.01–0.1 mg/L	> 0.1 mg/L
Hawaii, Puerto Rico, and Florida Bay sites	< 0.005 mg/L	0.005–0.01 mg/L	> 0.01 mg/L
Regions	Less than 10% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition.	10% to 25% of the coastal area is in poor condition, or more than 50% of the coastal area is in combined poor and fair condition.	More than 25% of the coastal area is in poor condition.

measured as color; and by phytoplankton levels in a waterbody. The naturally turbid waters of estuaries, however, can also be valuable to society. Turbid waters can support healthy and productive ecosystems by supplying building materials for maintaining estuarine structures (e.g., coastal wetlands) and providing food and protection to resident organisms; however, turbid waters can be harmful to coastal ecosystems if sediment loads bury benthic communities, inhibit filter feeders, or block light needed by seagrasses.

NCA estimates water clarity using specialized equipment that compares the amount and type of light reaching the water surface to the light at a depth of 1 meter, as well as by using a Secchi disk. Local variability in water clarity occurs between the different regions within an estuary, as well as at a single location in an estuary due to tides, storm events, wind mixing, and changes in incident light. The probabilistic nature of the NCA study design accounts for this local variability when the results are assessed on larger regional or national scales. Water clarity also varies naturally among various parts of the nation; therefore, the water clarity indicator is based on a ratio of observed clarity compared to regional reference conditions at 1 meter. The regional reference conditions were determined by examining available data for each of the U.S. regions (Smith et al., 2006). Reference conditions for a site rated poor were set at 10% of incident light available at a depth of 1 meter for normally turbid locations (most of the United States), 5% for locations with naturally high turbidity (Alabama, Louisiana, Mississippi, South Carolina, Georgia, and Delaware Bay), and 20% for regions of the country with significant SAV beds or active programs for SAV restoration (Laguna Madre, the Big Bend region of Florida, the region from Tampa Bay to Florida Bay, the Indian River Lagoon, and portions of Chesapeake Bay). Table 1-5 summarizes the rating criteria for water clarity for each monitoring station and for the regions.

Dissolved Oxygen

Dissolved oxygen is necessary for all aquatic life. Often, low dissolved oxygen conditions occur as a result of large algal blooms that sink to the bottom, where bacteria use oxygen as they degrade the algal mass. In addition, low dissolved oxygen conditions can be the result of stratification due to strong, freshwater river discharge on the surface,

Table 1-4. Criteria for Assessing Chlorophyll *a*

Area	Good	Fair	Poor
Northeast, Southeast, Gulf, and West Coast sites	< 5 µg/L	5–20 µg/L	> 20 µg/L
Hawaii, Puerto Rico, and Florida Bay sites	< 0.5 µg/L	0.5–1 µg/L	> 1 µg/L
Regions	Less than 10% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition.	10% to 20% of the coastal area is in poor condition, or more than 50% of the coastal area is in combined poor and fair condition.	More than 20% of the coastal area is in poor condition.

Table 1-5. Criteria for Assessing Water Clarity

Area	Good	Fair	Poor
Sites in coastal waters with naturally high turbidity	> 10% light at 1 meter	5–10% light at 1 meter	< 5% light at 1 meter
Sites in coastal waters with normal turbidity	> 20% light at 1 meter	10–20% light at 1 meter	< 10% light at 1 meter
Sites in coastal waters that support SAV	> 40% light at 1 meter	20–40% light at 1 meter	< 20% light at 1 meter
Regions	Less than 10% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition.	10% to 25% of the coastal area is in poor condition, or more than 50% of the coastal area is in combined poor and fair condition.	More than 25% of the coastal area is in poor condition.

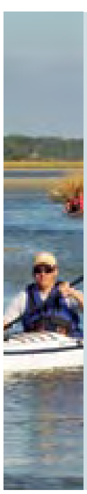
which overrides the heavier, saltier bottom water of a coastal waterbody. Many states use a dissolved oxygen threshold average concentration of 4 to 5 mg/L to set their coastal water quality standards, and concentrations below 2 mg/L are thought to be stressful to many organisms (Diaz and Rosenberg, 1995; U.S. EPA, 2000a). These low levels (hypoxia) or a lack of oxygen (anoxia) most often occur in bottom waters and affect the organisms that live in the sediments. Hypoxia frequently accompanies the onset of severe bacterial degradation, sometimes resulting in the presence of algal scums and noxious odors; however, in some coastal waters, low dissolved oxygen levels occur periodically or may be a part of the waterbody's natural ecology. Therefore, although it is easy to show a snapshot of the dissolved oxygen conditions in the nation's coastal waters, it is difficult to interpret whether any poor conditions in this snapshot are representative of eutrophication or the result of natural physical processes. In addition, the snapshot may not be representative of all summertime periods, such as variable daily conditions (see text box). Unless otherwise noted, the dissolved oxygen data presented in this report were collected by NCA at a depth of 1 meter above the sediment at each station on only one day during the year. Dissolved oxygen concentrations at individual monitoring sites and over regions were rated good, fair, or poor using the criteria shown in Table 1-6.

Table 1-6. Criteria for Assessing Dissolved Oxygen

Area	Good	Fair	Poor
Individual sampling sites	> 5 mg/L	2–5 mg/L	< 2 mg/L
Regions	Less than 5% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition.	5% to 15% of the coastal area is in poor condition, or more than 50% of the coastal area is in combined poor and fair condition.	More than 15% of the coastal area is in poor condition.

Calculating the Water Quality Index

Once DIN, DIP, chlorophyll *a*, water clarity, and dissolved oxygen were assessed for a given site, the water quality index rating was calculated for the site based on these five component indicators. The index was rated good, fair, poor, or missing using the criteria shown in Table 1-7. A water quality index was then calculated for each region using the criteria shown in Table 1-8.



Temporal variations in dissolved oxygen depletion can have adverse biological effects (Coiro et al., 2000). Stressful hypoxia may occur for a few hours before dawn in productive surface waters, when respiration depletes dissolved oxygen faster than it is replenished. The NCA does not measure these events because most samples are collected later in the day. The NCA estimates do not apply to dystrophic systems, in which dissolved oxygen levels are acceptable during daylight hours, but decrease to low (even unacceptable) levels during the night. Many of these systems and the biota associated with them are adapted to this cycle—a natural process of oxygen production during the day and respiration at night—which is common in wetland, swamp, and blackwater ecosystems. NCA sampling does not address the duration of hypoxic events because each station is sampled on only one day during the summer. In addition, year-to-year variations in estuarine dissolved oxygen levels can be substantial as a result of a variety of factors, including variations in freshwater inflow, factors affecting water-column stratification, and changes in nutrient delivery.

Table 1-7. Criteria for Determining the Water Quality Index Rating by Site

Rating	Criteria
Good	A maximum of one indicator is rated fair, and no indicators are rated poor.
Fair	One of the indicators is rated poor, or two or more indicators are rated fair.
Poor	Two or more of the five indicators are rated poor.
Missing	Two component indicators are missing, and the available indicators do not suggest a fair or poor rating.

Table 1-8. Criteria for Determining the Water Quality Index Rating by Region

Rating	Criteria
Good	Less than 10% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition.
Fair	10% to 20% of the coastal area is in poor condition, or more than 50% of the coastal area is in combined fair and poor condition.
Poor	More than 20% of the coastal area is in poor condition.

Tide pool in southern California (courtesy of Brad Ashbaugh).

Sediment Quality Index

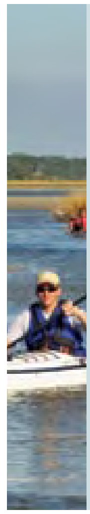
Another issue of major environmental concern in coastal waters is the contamination of sediments with toxic chemicals. A wide variety of metals and organic substances, such as polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and pesticides, are discharged into coastal waters from urban, agricultural, and industrial sources in a watershed. These contaminants adsorb onto suspended particles and eventually accumulate in depositional basins, where they can disrupt the benthic community of invertebrates, shellfish, and crustaceans that live in or on the sediments. To the extent that the contaminants become concentrated in the organisms, they pose a risk to organisms throughout the food web—including humans.

Several factors influence the extent and severity of contamination. Fine-grained, organic-rich sediments are likely to become resuspended and transported to distant locations and are also efficient at scavenging pollutants. Thus, silty sediments high in TOC are potential sources of contamination. Conversely, organic-rich particles bind some toxicants so strongly that the threat to organisms can be greatly reduced. The NCA collected sediment samples, measured the concentrations of chemical constituents and percent TOC in the sediments, and evaluated sediment toxicity by measuring the survival of the marine amphipod *Ampelisca abdita* following a 10-day exposure to the sediments under laboratory conditions. The results of these evaluations may be used to identify the most-polluted areas and provide clues regarding the sources of contamination.

The physical and chemical characteristics of surface sediments are the result of interacting forces controlling chemical input and particle dynamics at any particular site. When assessing coastal condition, researchers measure the potential for sediments to affect bottom-dwelling organisms. The sediment quality index is based on measurements of three component indicators of sediment condition: sediment toxicity, sediment contaminants, and sediment TOC.

Some researchers and managers would prefer that the sediment triad (sediment chemistry, sediment toxicity, and benthic communities) be used to assess sediment condition (poor condition would require all three elements to be poor), or that poor sediment condition be determined based on the joint occurrence of elevated sediment contaminant concentrations and high sediment toxicity (see text box, *Alternative Views for a Sediment Quality Index*). However, benthic community attributes are included in this assessment of coastal condition as an independent variable rather than as a component of sediment quality.

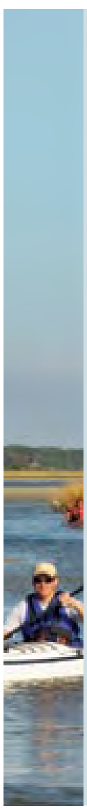
In this report, the focus of the sediment quality index is on sediment condition, not just sediment toxicity. Attributes of sediments other than toxicity can result in unacceptable changes in biotic communities. For example, organic enrichment through wastewater disposal can have an undesired effect on biota, and elevated contaminant levels can have undesirable ecological effects (e.g., changes in benthic community structure) that are not directly related to acute toxicity (as measured by the *Ampelisca* test). For these reasons, the sediment quality index in this report uses the combination of sediment toxicity, sediment contaminants, and sediment TOC to assess sediment condition. Sediment condition is assessed as poor (i.e., high potential for exposure effects on biota) at a site if any one of the component indicators is categorized as poor; assessed as fair if the sediment contaminants indicator is rated fair; and assessed as good if all three component indicators are at levels that would be unlikely to result in adverse biological effects due to sediment quality.



Guidelines for Assessing Sediment Contamination (Long et al., 1995)

ERM (Effects Range Median)—Determined values for each chemical as the 50th percentile (median) in a database of ascending concentrations associated with adverse biological effects.

ERL (Effects Range Low)—Determined values for each chemical as the 10th percentile in a database of ascending concentrations associated with adverse biological effects.



Alternative Views for a Sediment Quality Index

Some resource managers object to using ERM and ERL values to calculate the sediment quality index because the index is also based on actual measurements of toxicity. Because ERMs are defined as the concentration at which 50% of samples will exhibit toxicity, these managers believe that the same weight should not be given to a non-toxic sample with an ERM exceedance as is given to a sample that is actually toxic. O'Connor et al. (1998), using a 1,508-sample EPA and NOAA database, found that 38% of ERM exceedances coincided with amphipod toxicity (i.e., were toxic), 13% of the ERL exceedances (no ERM exceedance) were toxic; and only 5% of the samples that did not exceed ERL values were toxic. O'Connor and Paul (2000) expanded the 1,508-sample data set to 2,475 samples, and the results remained relatively unchanged (41% of the ERM exceedances were toxic, and only 5% of the non-exceedances were toxic). In a database generated in the EPA National Sediment Quality Survey (U.S. EPA, 2001d), 2,761 samples were evaluated with matching sediment chemistry and 10-day amphipod toxicity. Of the 762 samples with at least one ERM exceedance, 48% were toxic, and of the 919 samples without any ERLs exceedances, only 8% were toxic (Ingersoll et al., 2005). These data also showed a consistent pattern of increasing incidence of toxicity as the numbers of ERMs that were exceeded increased. Although, these analyses are consistent with the narrative intent of ERMs to indicate an incidence of toxicity of about 50% and ERLs to indicate an incidence of toxicity of about 10%, some researchers and managers believe that the sediment quality index used in this report should not result in a poor rating if sediment contaminant criteria are exceeded, but the sediment is not shown to be toxic in bioassays.

Sediment Toxicity

Researchers applied a standard direct test of toxicity at thousands of sites to measure the survival of amphipods (commonly found, shrimp-like benthic crustaceans) exposed to sediments for 10 days under laboratory conditions (U.S. EPA, 1995a). As in all tests of toxicity, survival was measured relative to that of amphipods exposed to uncontaminated reference sediment. The criteria for rating sediment toxicity based on amphipod survival for each sampling site are shown in Table 1-9. Table 1-10 shows how these site data were used to evaluate sediment toxicity by region. It should be noted that for this component indicator, unlike the others outlined in this report, only a good or poor rating is possible—there is no fair rating.

Table 1-9. Criteria for Assessing Sediment Toxicity by Site

Rating	Criteria
Good	The amphipod survival rate is greater than or equal to 80%.
Poor	The amphipod survival rate is less than 80%.

Table 1-10. Criteria for Assessing Sediment Toxicity by Region

Rating	Criteria
Good	Less than 5% of the coastal area is in poor condition.
Poor	5% or more of the coastal area is in poor condition.

Sediment Contaminants

There are no absolute chemical concentrations that correspond to sediment toxicity, but ERL and ERM values (Long et al., 1995) are used as guidelines in assessing sediment contamination (Table 1-11). ERM is the median concentration (50th percentile) of a contaminant observed to have adverse biological effects in the literature studies examined. A more protective indicator of contaminant concentration is the ERL criterion, which is the 10th percentile concentration of a contaminant represented by studies demonstrating adverse biological effects in the literature. Ecological effects are not likely to occur at contaminant concentrations below the ERL criterion. The criteria for rating sediment contaminants at individual sampling sites are shown in Table 1-12, and Table 1-13 shows how these data were used to create regional ratings for the sediment contaminants component indicator.

Table 1-11. ERM and ERL Guidelines for Sediment (Long et al., 1995)

Metal*	ERL	ERM
Arsenic	8.2	70
Cadmium	1.2	9.6
Chromium	81	370
Copper	34	270
Lead	46.7	218
Mercury	0.15	0.71
Nickel	20.9	51.6
Silver	1	3.7
Zinc	150	410
Analyte**	**ERL**	**ERM**
Acenaphthene	16	500
Acenaphthylene	44	640
Anthracene	85.3	1,100
Flourene	19	540
2-Methylnaphthalene	70	670
Naphthalene	160	2,100
Phenanthrene	240	1,500
Benz(a)anthracene	261	1,600
Benzo(a)pyrene	430	1,600
Chrysene	384	2,800
Dibenzo(a,h)anthracene	63.4	260
Fluoranthene	600	5,100
Pyrene	665	2,600
Low molecular-weight PAH	552	3,160
High molecular-weight PAH	1,700	9,600
Total PAHs	4,020	44,800
4,4'-DDE	2.2	27
Total DDT	1.6	46.1
Total PCBs	22.7	180

*units are µg/g dry sediment, equivalent to ppm
**units are ng/g dry sediment, equivalent to ppb

Table 1-12. Criteria for Assessing Sediment Contaminants by Site

Rating	Criteria
Good	No ERM concentrations are exceeded, and less than five ERL concentrations are exceeded.
Fair	No ERM concentrations are exceeded, and five or more ERL concentrations are exceeded.
Poor	An ERM concentration is exceeded for one or more contaminants.

Table 1-13. Criteria for Assessing Sediment Contaminants by Region

Rating	Criteria
Good	Less than 5% of the coastal area is in poor condition.
Fair	5% to 15% of the coastal area is in poor condition.
Poor	More than 15% of the coastal area is in poor condition.

Sediment TOC

Sediment contaminant availability or organic enrichment can be altered in areas where there is considerable deposition of organic matter. Although TOC exists naturally in coastal sediments and is the result of the degradation of autochthonous and allochthonous organic materials (e.g., phytoplankton, leaves, twigs, dead organisms), anthropogenic sources (e.g., organic industrial wastes, untreated or only primary-treated sewage) can significantly elevate the level of TOC in sediments. TOC in coastal sediments is often a source of food for some benthic organisms, and high levels of TOC in coastal sediments can result in significant changes in benthic community structure and in the predominance of pollution-tolerant species. Increased levels of sediment TOC can also reduce the general availability of organic contaminants (e.g., PAHs, PCBs, pesticides); however, increases in temperature or decreases in dissolved oxygen levels can sometimes result in the release of these TOC-bound and unavailable contaminants. Sediment toxicity from organic matter is assessed by measuring TOC. Regions of high TOC content are also likely to be depositional sites for fine sediments. If there are pollution sources nearby, these depositional sites are likely to be hot spots for contaminated sediments. The criteria for rating TOC at individual sampling sites are shown in Table 1-14, and Table 1-15 shows how these data were used to create a regional ranking.

Table 1-14. Criteria for Assessing TOC by Site (concentrations on a dry-weight basis)

Rating	Criteria
Good	The TOC concentration is less than 2%.
Fair	The TOC concentration is between 2% and 5%.
Poor	The TOC concentration is greater than 5%.

Table 1-15. Criteria for Assessing TOC by Region

Rating	Criteria
Good	Less than 20% of the coastal area is in poor condition.
Fair	20% to 30% of the coastal area is in poor condition.
Poor	More than 30% of the coastal area is in poor condition.

Courtesy of Andrew D. Stahl

Calculating the Sediment Quality Index

Once all three sediment quality component indicators (sediment toxicity, sediment contaminants, and sediment TOC) are assessed for a given site, a sediment quality index rating is calculated for the site. The sediment quality index was rated good, fair, or poor for each site using the criteria shown in Table 1-16. The sediment quality index was then calculated for each region using the criteria shown in Table 1-17.

Table 1-16. Criteria for Determining the Sediment Quality Index by Site

Rating	Criteria
Good	None of the individual component indicators is rated poor, and the sediment contaminants indicator is rated good.
Fair	None of the component indicators is rated poor, and the sediment contaminants indicator is rated fair.
Poor	One or more of the component indicators is rated poor.

Table 1-17. Criteria for Determining the Sediment Quality Index by Region

Rating	Criteria
Good	Less than 5% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition.
Fair	5% to 15% of the coastal area is in poor condition, or more than 50% of the coastal area is in combined poor and fair condition.
Poor	More than 15% of the coastal area is in poor condition.

Benthic Index

The worms, clams, crustaceans, and other invertebrates that inhabit the bottom substrates of coastal waters are collectively called benthic macroinvertebrates, or benthos. These organisms play a vital role in maintaining sediment and water quality and are an important food source for bottom-feeding fish, shrimp, ducks, and marsh birds. Benthos are often used as indicators of disturbance in coastal environments because they are not very mobile and thus cannot avoid environmental problems. Benthic population and community characteristics are sensitive to chemical-contaminant and dissolved-oxygen stresses, salinity fluctuations, and sediment disturbance and serve as reliable indicators of coastal environmental quality. To distinguish degraded benthic habitats from undegraded benthic habitats, EMAP and NCA have developed regional (Southeast, Northeast, and Gulf coasts) benthic indices of environmental condition (Engle et al., 1994; Weisberg et al., 1997; Engle and Summers, 1999; Van Dolah et al., 1999; Hale and Heltshe, 2008). These indices reflect changes in benthic community diversity and the abundance of pollution-tolerant and pollution-sensitive species. A high benthic index rating for benthos means that sediment samples taken from a waterbody contain a wide variety of benthic species, as well as a low proportion of pollution-tolerant species and a high proportion of pollution-sensitive species. A low benthic index rating indicates that the benthic communities are less diverse than expected, are populated by more pollution-tolerant species than expected, and contain fewer pollution-sensitive species than expected. The benthic condition data presented throughout this report were collected by the NCA unless otherwise noted. Indices vary by region because species assemblages depend on prevailing temperatures, salinities, and the silt-clay content of sediments. The benthic index was rated poor at a site when the index values for the Northeast, Southeast, and Gulf coasts' diversity or species richness, abundance of pollution-sensitive species, and abundance of pollution-tolerant species fell below a certain threshold.

Not all regions included in this report have developed benthic indices. Indices for the West Coast, Puerto Rico, Alaska, and Hawaii are under development and were unavailable for reporting at this time. In these regions, benthic community diversity or species richness were determined for each site as surrogates for the benthic index. Values for diversity or richness were compared with salinity regionally to determine if a significant relationship existed. This relationship was not significant for Southcentral Alaska and Hawaii, and no surrogate benthic index was developed; therefore, benthic community condition was not assessed for these regions. For the West Coast estuaries, there was a significant relationship between species richness and salinity (r^2 =0.43, $p < 0.01$). A surrogate benthic index was calculated by determining the expected species richness from the statistical relationship to salinity and then calculating the ratio of observed to expected species richness. Poor condition was defined as less than 75% of the expected benthic species richness at a particular salinity. As in Southcentral Alaska and Hawaii, the data from Puerto Rico showed no significant relationship between benthic diversity or species richness and salinity; however, a different approach was used to assess benthic condition in this region. Benthic diversity (H') was used as a surrogate for a benthic index for Puerto Rico by determining the mean and 95% confidence limits for diversity in unstressed benthic habitats (i.e., sites with no sediment contaminants, low TOC, and absence of hypoxia). Poor benthic condition was then defined as observed diversity less than 75% of the lower 95% confidence limit of mean diversity for unstressed habitats in Puerto Rico. Table 1-18 shows the good, fair, and poor rating criteria for the different regions of the country, which were used to calculate an overall benthic condition rating for each region.

Table 1-18. Criteria for Assessing Benthic Index

Area	Good	Fair	Poor
Northeast Coast sites			
Acadian Province	Benthic index score is greater than or equal to 5.0.	Benthic index score is greater than or equal to 4.0 and less than 5.0.	Benthic index score is less than 4.0.
Virginian Province	Benthic index score is greater than 0.0.	NA*	Benthic index score is less than 0.0.
Southeast Coast sites	Benthic index score is greater than 2.5.	Benthic index score is between 2.0 and 2.5.	Benthic index score is less than 2.0.
Gulf Coast sites	Benthic index score is greater than 5.0.	Benthic index score is between 3.0 and 5.0.	Benthic index score is less than 3.0.
West Coast sites (compared to expected diversity)	Benthic index score is more than 90% of the lower limit (lower 95% confidence interval) of expected mean diversity for a specific salinity.	Benthic index score is between 75% and 90% of the lower limit of expected mean diversity for a specific salinity.	Benthic index score is less than 75% of the lower limit of expected mean diversity for a specific salinity.
Southcentral Alaska and Hawaii sites	NA**	NA**	NA**
Puerto Rico sites (compared to upper 95% confidence interval for mean regional benthic diversity)	Benthic index score is more than 90% of the lower limit (lower 95% confidence interval) of mean diversity in unstressed habitats.	Benthic index score is between 75% and 90% of the lower limit of mean diversity in unstressed habitats.	Benthic index score is less than 75% of the lower limit of mean diversity in unstressed habitats.
Regions	Less than 10% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition.	10% to 20% of the coastal area is in poor condition, or more than 50% of the coastal area is in combined poor and fair condition.	More than 20% of the coastal area is in poor condition.

* By design, this index discriminates between good and poor conditions only.
**Benthic condition was not assessed in these regions.